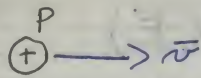


Tarea #3

21., 25, 29, 31, 43, 45

P 718)
21.27)



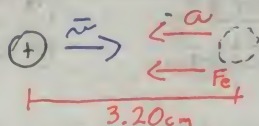
$$v = 4.50 \times 10^6 \text{ m/s}$$

$$m_p = 1.673 \times 10^{-27} \text{ Kg}$$

$$q_p = 1.6 \times 10^{-19} \text{ C}$$

a) $v_f = 0$

$$d = 3.20 \text{ cm}$$



$$v_f^2 + v_o^2 = 2 a \Delta x \Rightarrow a = \frac{v_f^2 + v_o^2}{2 \Delta x}$$

$$a = \frac{0 + (4.50 \times 10^6)^2}{2 (0.0320)} = -3.16 \times 10^{14} \Rightarrow -3.16 \times 10^{14} \text{ m/s}^2 (\text{?})$$

$$F = ma = (1.673 \times 10^{-27}) (-3.16 \times 10^{14}) = -5.29 \times 10^{-13} \text{ N} (\text{?})$$

$$E = \frac{F}{q} = \frac{-5.29 \times 10^{-13} \text{ N} (\text{?})}{1.6 \times 10^{-19} \text{ C}} = -3.31 \times 10^6 \frac{\text{N}}{\text{C}} (\text{?}) //$$

b) $\Delta x = v_o \Delta t + \frac{1}{2} a \Delta t^2 \mid a = \frac{\Delta v}{\Delta t}$

$$\left(\frac{v + v_o}{2} \right) \Delta t = \Delta x \rightarrow \text{Sólo para aceleración etc.}$$

$$\Delta t = \frac{2 \Delta x}{v_o} = \frac{2 (0.0320)}{4.50 \times 10^6} = 1.42 \times 10^{-8} \text{ s} //$$

c) $F = ma = (9.11 \times 10^{-31}) (-3.16 \times 10^{14}) = -2.88 \times 10^{-16} \text{ N} (\text{?})$

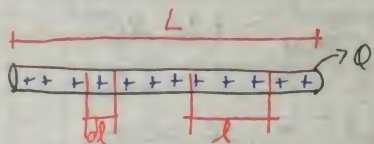
$$E = \frac{F}{q} = \frac{-2.88 \times 10^{-16}}{-1.6 \times 10^{-19}} = 1800 \frac{\text{N}}{\text{C}} (\text{?})$$

$\vec{F} = q \vec{E}$ si $q (+)$ \vec{F} misma dirección \vec{E}
si $q (-)$ \vec{F} dirección opuesta \vec{E}

21/7/14

Cargas Uniformemente Distribuidas

1) Densidad lineal de carga λ lambda



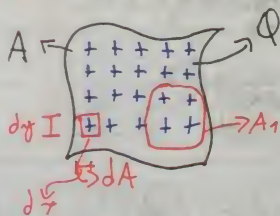
$$\lambda = \frac{\text{carga total}}{\text{Long. total}}$$

$$\lambda = \frac{Q}{L}$$

$$dq = \lambda dl$$

$$q = \lambda l$$

2) Densidad superficial de carga σ sigma

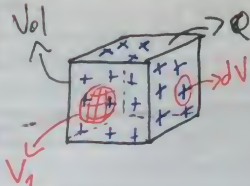


$$\sigma = \frac{Q}{A}$$

$$q = \sigma A_1$$

$$dq = \sigma dx dy$$

3) Densidad Volumétrica de carga ρ rho



$$\rho = \frac{Q}{V_1}$$

$$q = \rho V_1$$

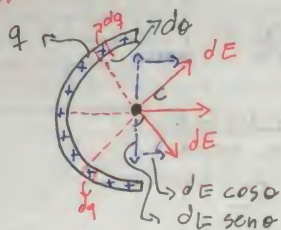
$$dq = \rho dV$$

$$dq = \rho dx dy dz$$

$$s = r\theta$$

$$l = \pi r \rightarrow \text{media circ.}$$

Ej) Calcule el campo eléctrico en "C".



$$l_{\text{varilla}} = 30 \text{ cm}$$

$$q_{\text{dist}} = +20 \mu\text{C}$$

$$E = \int dE = \int dE \cos \theta$$

$$E = \int k \frac{dq}{r^2} \cos \theta = \frac{k}{r^2} \int \lambda ds \cos \theta$$

por ser arco
por ser 1/4 circ

$$E = \frac{k}{r^2} \lambda \int r d\theta \cos \theta = \frac{k}{r^2} \lambda r \int_0^{\pi/2} \cos \theta d\theta$$

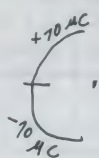
por ser dif de ángulo

$$E = \frac{2k\lambda}{r} \left[\sin \theta \right]_0^{\pi/2} = \frac{2k\lambda}{r} \left[1 \right]_0^{\pi/2}$$

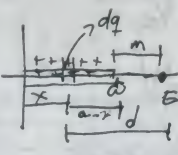
$$E = \frac{2k\pi q}{l^2} = \frac{2 * (9 \times 10^9) (\pi) (20 \times 10^{-6})}{(0.30)^2}$$

$$E = 1.26 \times 10^{-7} \frac{\text{N}}{\text{C}} (\hat{z})$$

Tarea #4



21, 47, 61, 73
71



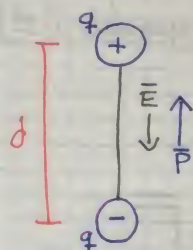
$$\lambda = \frac{q}{a}$$

$$dE = k \frac{dq}{r^2} \Rightarrow E = \int dE$$

$$E = k \int_0^a \frac{\lambda dx}{(a+m-x)^2}$$

23/7/74

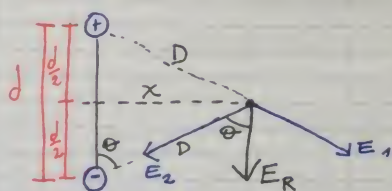
Dipolo Eléctrico



Momento dipolar

$$\vec{p} = q d \text{ Hacia la carga positiva}$$

Campo eléctrico debido a un dipolo



$$E_R = 2 E_1 \cos \theta$$

$$E_R = 2 K \frac{q}{r^2} \cos \theta$$

$$E_R = 2 K \left(\frac{q}{D^2} \right) (\cos \theta)$$

$$D = \sqrt{\left(\frac{d}{2}\right)^2 + x^2}$$

$$E = 2 K \left(\frac{q}{\left(\frac{d}{2}\right)^2 + x^2} \right) \left(\frac{\frac{d}{2}}{\sqrt{\left(\frac{d}{2}\right)^2 + x^2}} \right) = K \frac{q d}{\left(\left(\frac{d}{2}\right)^2 + x^2\right)^{3/2}}$$

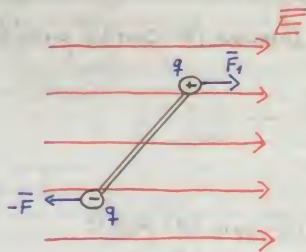
$$\boxed{E = K \frac{P}{\left[\left(\frac{d}{2}\right)^2 + x^2\right]^{3/2}}} \rightarrow \vec{E} \text{ en direcccion } -\vec{p}$$

Para $x \gg d$
$$E = K \frac{P}{x^3}$$

Tarea 5: 21... 57, 59, 69, 75

Un dipolo dentro de un campo eléctrico constante:

- Lo produce una o mas placas cargadas (\vec{E})



$$\vec{F} = q\vec{E}$$

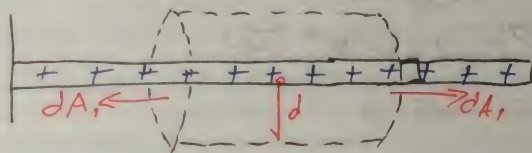
Torque:

$$\vec{\tau} = \vec{r} \times \vec{F}$$

1/8/14

Aplicaciones de la Ley de Gauss

22.18



$$d = 0.100 \text{ m}$$

$$E = 84 \text{ N/C}$$

$$q = ?$$

$$l = 20 \text{ cm}$$

$$\oint E \cdot dA = \frac{q_{\text{enc}}}{\epsilon_0}$$

$$\int E dA \cos 0^\circ = \frac{\lambda L}{\epsilon_0} \Rightarrow E \int dA = \frac{\lambda L}{\epsilon_0}$$

$$E = \frac{\lambda}{\epsilon_0 (2\pi d)} \Rightarrow \lambda = E 2\pi \epsilon_0 d$$

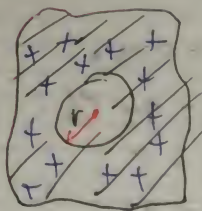
$$\lambda = \frac{q}{l} \Rightarrow q = \lambda l \Rightarrow q = E 2\pi \epsilon_0 d l$$

$$q = 840 \times 2\pi (8.85 \times 10^{-12}) (0.100) (0.20)$$

$$q = 3.74 \times 10^{-10} \text{ C}$$

22... 15, 17, 19, 1, 2, 3, 5
preg

22.22)



$$q = -200 \mu\text{C}$$

$$r = 6.50 \text{ cm}$$

$$\rho = 7.35 \times 10^{-4} \text{ C/m}^3$$

$$d = 9.50 \text{ cm}$$

$$\oint E \cdot dA = \frac{q_{\text{NE}}}{\epsilon_0} \Rightarrow \oint E dA \cos \theta = \frac{q_{\text{NE}}}{\epsilon_0}$$

$$\Rightarrow \oint dA = \frac{q_{\text{NE}}}{\epsilon_0} \Rightarrow E(4\pi d^2) = \frac{q_{\text{NE}}}{\epsilon_0}$$

$$q_{\text{NE}} = -2.00 \times 10^{-4} + \rho V_L$$

$$q_{\text{NE}} = -2.00 \times 10^{-4} + \rho \left(\frac{4}{3} \pi (d^3 - r^3) \right)$$

$$q_{\text{NE}} = -2.00 \times 10^{-4} + 7.25 \times 10^{-4} \left(\frac{4}{3} \pi (0.0095^3 - 0.0065^3) \right)$$

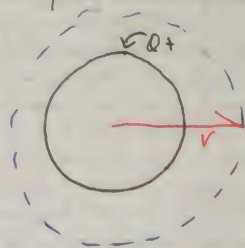
$$q_{\text{NE}} = -0.206 \mu\text{C}$$

$$E(4\pi d^2) = \frac{q_{\text{NE}}}{\epsilon_0} \Rightarrow E = \frac{1}{4\pi\epsilon_0} \frac{q_{\text{NE}}}{d^2}$$

$$E = 9 \times 10^9 \times \frac{0.206 \times 10^{-6}}{(0.0950)^2} = 2.05 \times 10^5 \text{ N/C}$$

4/7/14

Campo Eléctrico debido a una esfera cargada



$E = ?$

$$\oint E dA = \frac{q_{NE}}{\epsilon_0}$$

$$\oint E dA \cos \alpha = \frac{Q}{\epsilon_0}$$

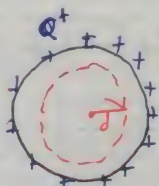
Afuera
no importa
si es o no
es conductora

$$E \oint dA = \frac{Q}{\epsilon_0} \Rightarrow EA = \frac{Q}{\epsilon_0} \Rightarrow E \cdot 4\pi r^2 = \frac{Q}{\epsilon_0}$$

$$E = \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2} \Rightarrow E = K \frac{Q}{r^2}$$

Dentro de la esfera

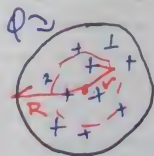
1) Esfera conductora



$$\oint E dA = \frac{q_{NE}}{\epsilon_0} \Rightarrow \oint E dA \cos \alpha = \frac{0}{\epsilon_0}$$

$$E \oint dA = 0 \Rightarrow E = 0$$

2) No conductora



$$\rho = \frac{Q}{V_0} \Rightarrow \rho = \frac{Q}{\frac{4}{3}\pi R^3}$$

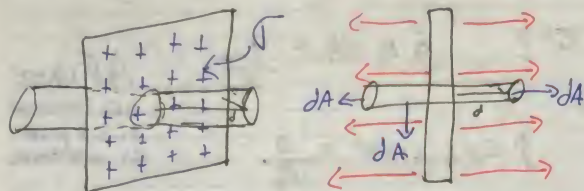
$$\oint E dA = \frac{q_{NE}}{\epsilon_0} \Rightarrow \oint E dA = \frac{q_{NE}}{\epsilon_0}$$

$$E \oint dA = \frac{\rho V_0}{\epsilon_0} \Rightarrow E 4\pi r^2 = \frac{\frac{Q}{\frac{4}{3}\pi R^3} \times \frac{4}{3}\pi r^3}{\epsilon_0}$$

$$E = \frac{1}{4\pi\epsilon_0} \times \frac{Qr}{R^3}$$

22... 21, 23, 25, 27, 47

Campo eléctrico debido a una placa no conductora

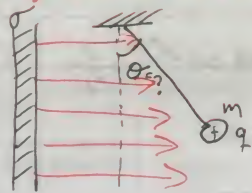


$$\oint E \cdot dA = \frac{q_{\text{enc}}}{\epsilon_0} \Rightarrow \int E dA_1 + \int E dA_2 = \frac{q_{\text{enc}}}{\epsilon_0}$$

$$A_1 E + A_2 E = \frac{\sigma A}{\epsilon_0} \Rightarrow A E + A E = \frac{\sigma A}{\epsilon_0}$$

$$2E = \frac{\sigma}{\epsilon_0} \Rightarrow E = \frac{\sigma}{2\epsilon_0}$$

22.43) Figura en libro mala

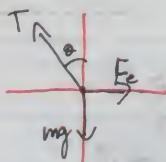


$$\sigma = 2.50 \times 10^{-9} \frac{\text{C}}{\text{m}^2}$$

$$q = 5.00 \times 10^{-6} \text{ C}$$

$$m = 4.00 \times 10^{-6} \text{ kg}$$

D.C.L.



$$\sum F_y = 0 \Rightarrow T_y = mg$$

$$T \cos \theta = mg \Rightarrow T = \frac{mg}{\cos \theta}$$

$$\sum F_x = 0 \Rightarrow F_e = T_x$$

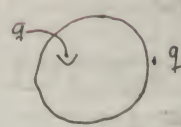
$$Eq = T \sin \theta \Rightarrow \frac{\sigma q}{2\epsilon_0} = \frac{mg}{\cos \theta} \sin \theta$$

$$\frac{\sigma q}{2\epsilon_0 mg} = \tan \theta \Rightarrow \tan \theta = \frac{(2.50 \times 10^{-9})(5 \times 10^{-6})}{2(8.85 \times 10^{-12})(4 \times 10^{-6})(9.8)} \Rightarrow \theta = 10.21^\circ$$

22... 33, 35, 45, 49, 51 / 11, 12, 13
Preg

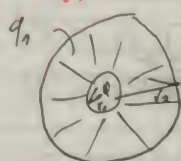
22.27)

$w = \int \vec{E} \cdot d\vec{x}$



$$\int_r^\infty \vec{E} \cdot d\vec{x} = \int_r^\infty E q dx = \int_r^\infty \frac{k q_1 q_2}{x^2} = k q_1 q_2 \int_r^\infty \frac{dx}{x^2}$$

22.28)



a) sup interior del conductor

$q_1 = 5 \mu C$

b) sup ext. del conductor

$q_2 = 6 \mu C$

$r_1 = 5 \text{ cm}$

$E = ? \quad d_1 = 3 \text{ cm}$

$r_2 = 10 \text{ cm}$

$E = ? \quad d_2 = 8 \text{ cm}$

$E = ? \quad d_3 = 15 \text{ cm}$

$\oint E \cdot dA = \frac{q_{enc}}{\epsilon_0}$

$\oint E \cdot dA \cos 180 = \frac{q_2}{\epsilon_0} \Rightarrow E \int dA = \frac{q_2}{\epsilon_0}$

$E(4\pi d_1^2) = \frac{q_2}{\epsilon_0} \Rightarrow E = \frac{1}{4\pi\epsilon_0} \frac{q_2}{d_1^2}$

$E = (9 \times 10^9) \frac{(6 \times 10^{-9})}{(0.03)^2} = 60,000 \text{ N/C}$

$d = 8 \text{ cm}$

$\oint E \cdot dA = \frac{q_{enc}}{\epsilon_0} \Rightarrow \oint E \cdot dA \cos 90 = \frac{0}{\epsilon_0} \Rightarrow E = 0$

$d = 15 \text{ cm}$

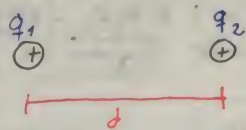
$\oint E \cdot dA \cos 180 = \frac{q_1 + q_2}{\epsilon_0} \Rightarrow \oint E \cdot dA = \frac{1 \times 10^{-9}}{\epsilon_0}$

$E = 9 \times 10^9 \times \frac{1 \times 10^{-9}}{(0.15)^2} = 400 \text{ N/C}$

Si sólo hay una carga no hay trabajo

8/8/14

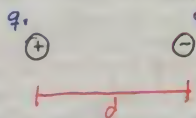
Energía Potencial Eléctrica



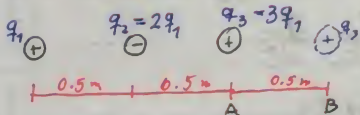
$$U = W = \int dW = \int \vec{F} \cdot d\vec{x}$$

$$= \int_0^d F dx \cos 0^\circ = \int_0^d k \frac{q_1 q_2}{x^2} dx = k q_1 q_2 \int_0^d \frac{dx}{x^2}$$

$$U = \frac{k q_1 q_2}{d}$$



Trabajo negativo



W para mover q_3 de A a B

$$q_1 = 12 \mu C$$

$$U_0 = k \frac{q_1 q_2}{d_{12}} + k \frac{q_2 q_1}{d_{13}} + k \frac{q_2 q_3}{d_{23}}$$

$$U_0 = \left[\frac{k (2q_1^2)}{0.50} \right] + \frac{3q_1^2}{1.00} - \frac{6q_1^2}{0.50} = (9 \times 10^9) \left[\frac{12 \times 10^{-6}}{0.5} - \frac{2}{1} + \frac{3}{0.5} \right]$$

$$U_0 = -16.85 \text{ J}$$

P1 24 Agosto

Resumen cap. 23

en B

$$U_F = K \left(\frac{-2q_1^2}{0.5} + \frac{3q_1^2}{1.50} - \frac{6q_1^2}{1} \right)$$

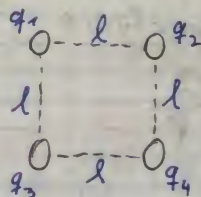
$$U_F = 9 \times 10^9 \times (12 \times 10^{-9})^2 \left[-\frac{2}{0.5} + \frac{3}{1.5} - \frac{6}{1} \right]$$

$$U_F = -10.37 \text{ J}$$

$$W = \Delta U = U_F - U_0 = -10.37 - (-16.85)$$

$$W = 6.48 \text{ J}$$

Ej) Energía en sistema



$$U = K \frac{q_1 q_2}{l} + K \frac{q_1 q_3}{l} + K \frac{q_2 q_3}{\sqrt{2}l} + K \frac{q_1 q_4}{\sqrt{2}l} + K \frac{q_2 q_4}{l} + K \frac{q_3 q_4}{l}$$

$$F = K \frac{q_1 q_2}{d^2}$$

$$E = \frac{F}{q_0}$$

Vectores $E = K \frac{q}{d^2}$

$$U = K \frac{q_1 q_2}{d}$$

$$V = \frac{U}{q_0}$$

Escalares $V = K \frac{q}{d}$

Los e⁻ buscan regiones de alto potencial
 Campo E dentro Cond = 0

11/8/14

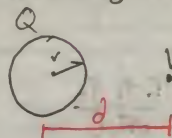
Potencial Eléctrico (V)

$$V = \frac{U}{q_0} = \frac{[J]}{[C]} = \text{Volt}$$

$q \oplus$ $\cdot q_0$ $V=?$ $V = \frac{U}{q_0} \Rightarrow V = \frac{K q q_0}{d q_0}$

$$V = K \frac{q}{d}$$

Esfera Cargada:



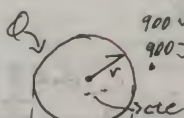
$V=?$

$$V = K \frac{q}{d}$$

en la superficie

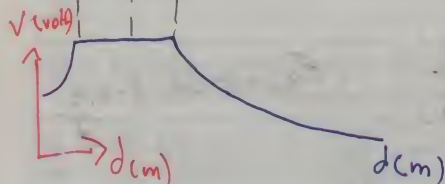
$$V = K \frac{Q}{R}$$

Esfera Conductora

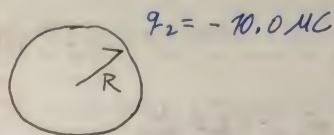
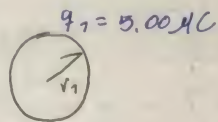


900 V
900 J

100 V
V = 100 J



23... 1, 3, 5, 11, 15



$$r = 20 \text{ cm}$$

$$V_1 = V_2$$

$$R = 30 \text{ cm}$$

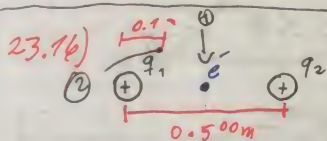
$$K \frac{q_1}{r} = K \frac{q_2}{R} \Rightarrow q_1 = \frac{r}{R} q_2$$

$$q_1 + q_2 = -5 \text{ nC}$$

$$q_1 = \frac{20}{30} q_2 \Rightarrow q_1 = \frac{2}{3} q_2$$

$$\frac{2}{3} q_2 + q_2 = -5 \text{ nC} \Rightarrow q_2 = \frac{3}{5} (-5 \text{ nC})$$

$$q_2 = -3 \text{ nC} \quad q_1 = -2 \text{ nC}$$



$$q_1 = 3.00 \text{ nC}$$

$$q_2 = 2.00 \text{ nC}$$

$$V = \frac{U}{q}$$

$$\Delta V = \frac{\Delta U}{q}$$

$$q \Delta V = \Delta U$$

$$V_1 = K \frac{q_1}{d_1} + K \frac{q_2}{d_2}$$

$$V_1 = (9 \times 10^9) \left(\frac{3 \times 10^{-9}}{0.25} \right) + (9 \times 10^9) \left(\frac{2 \times 10^{-9}}{0.25} \right) = 180 \text{ V}$$

$$V_2 = K \frac{q_1}{d'_1} + K \frac{q_2}{d'_2}$$

$$V_2 = (9 \times 10^9) \left(\frac{3 \times 10^{-9}}{0.1} \right) + (9 \times 10^9) \left(\frac{2 \times 10^{-9}}{0.40} \right) = 315 \text{ V}$$

$$\Delta V q = \Delta U \Rightarrow (V_2 - V_1) q = K_e - K_o \Rightarrow \frac{1}{2} m v_2^2 = (315 - 180) (1.6 \times 10^{-19})$$

cambio de energía

$$v_2 = \sqrt{\frac{2(315 - 180)(1.6 \times 10^{-19})}{9.11 \times 10^{-31}}} = 6.89 \times 10^6 \text{ m/s}$$

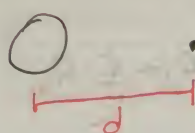
23.24)

$$V = 4.98 \text{ V}$$

$$E = 12.0 \frac{\text{V}}{\text{m}} = 12.0 \frac{\text{N}}{\text{C}}$$

a) $d = ?$

b) $q = ?$



$$V = k \frac{q}{d} = 4.98$$

$$E = k \frac{q}{d^2} = k \frac{q}{d} \times \frac{1}{d} = 12.0$$

$$4.98 \times \frac{1}{d} = 12 \Rightarrow d = \frac{4.98}{12} = 0.415 \text{ m}$$

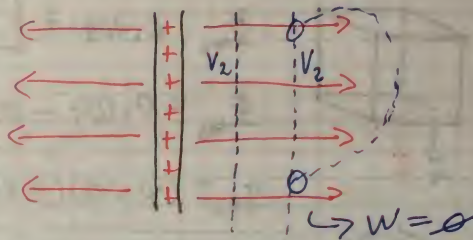
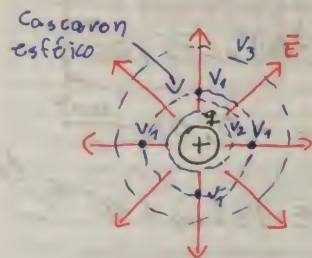
$$E = \frac{V}{d} \Rightarrow V = Ed$$

$$q = \frac{Vd}{k} = \frac{4.98 \times 0.415}{9 \times 10^9} = 2.30 \times 10^{-10} \text{ C}$$

$$q = \frac{Ed^2}{k} = \frac{12 (0.415)^2}{9 \times 10^9} = 2.30 \times 10^{-10} \text{ C}$$

Líneas equipotenciales siempre son perpendiculares
a las líneas de campo 18/8/14

Líneas Equipotenciales



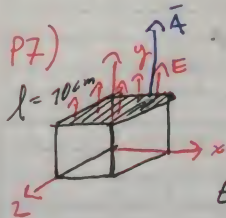
P6, T11)

$$E_s = -\frac{dV}{ds} \Rightarrow E_x = -\frac{dV}{dx} \text{ ó } E_y = -\frac{dV}{dy}$$

$$V = 8y^2 - 12y + 25 \text{ en } (2, 3, 4)$$

$$E_y = -16y + 12$$

$$E(3) = (-16(3) + 12) \hat{y} = -36 \frac{N}{C} \hat{y} \quad (c)$$



$$\Phi = E \cdot A$$

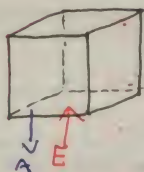
$$\Phi(0,10) = E \cdot A \cos 0^\circ$$

$$E(0,10) = -16(0,10) + 12 = 10,4 \text{ N/C}$$

$$\Phi = (10,4)(0,10)^2(1) = 0,104 \frac{Nm^2}{C} \quad (a)$$

Tarea T11

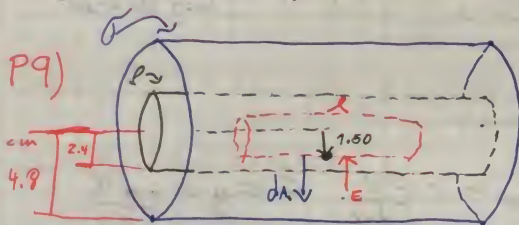
P8) $\oint \vec{E} \cdot d\vec{A} = \frac{q_{NE}}{\epsilon_0} \Rightarrow q_{NE} = \Phi_{Tot} \epsilon_0$



$$\Phi_{Tot} = 0.104 + \left[\vec{E} \cdot (\vec{n} \times (0.100)^2 \times \cos 180^\circ) \right]$$

$$\Phi_{Tot} = 0.104 - 0.120 = -0.016 \frac{Nm^2}{C}$$

$$q_{NE} = (-0.016)(8.85 \times 10^{-12}) = 141.6 \times 10^{-15} C^{(d)}$$



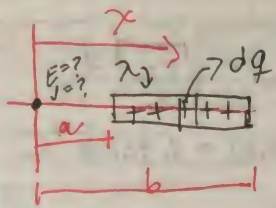
$$\rho = -1.50 \times 10^{-5} C/m^3$$

$$\sigma = +3.50 \times 10^{-6} C/m^2$$

$$\oint \vec{E} \cdot d\vec{A} = \frac{q_{NE}}{\epsilon_0} \Rightarrow E \int dA_1 = \frac{\rho Vol_1}{\epsilon_0}$$

$$E (2\pi r l) = \frac{\rho \pi r^2 l}{\epsilon_0} \Rightarrow E = \frac{\rho r}{2\epsilon_0}$$

$$E = \frac{1.50 \times 10^{-5} \times 0.0150}{2 (8.85 \times 10^{-12})} = 12,712 \frac{N}{C}$$

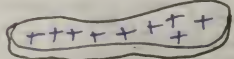


$$E = K \int \frac{dq}{r^2} = K \int_a^b \frac{\lambda dx}{x^2} = K \lambda \int_a^b \frac{dx}{x^2}$$

Capacitancia (C)

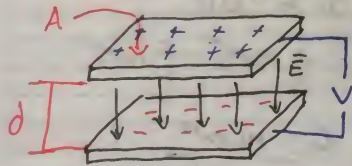


$$C = \frac{q}{V}$$



$$[C] = \frac{[C]}{[V]} = \text{Farad} [F]$$

Capacitores de Placas Planas Paralelas



$$C = \frac{q}{V} \Rightarrow C = \frac{q}{E d} \Rightarrow C = \frac{q}{\frac{q}{\epsilon_0 A} d}$$

$$C = \frac{\epsilon_0 q}{\frac{q}{A} d} \Rightarrow \boxed{C = \epsilon_0 \frac{A}{d}}$$

HP1

4) $\leftarrow F$ \ominus q $\rightarrow F$

$$F_c = k \frac{q^2}{d^2} \Rightarrow q = \sqrt{\frac{F_c}{k}} d$$

$$q = \sqrt{\frac{4.57 \times 10^{-21}}{9 \times 10^9}} (0.2) = 1.42 \times 10^{-16} C$$

$$\#C = \frac{1.42 \times 10^{-16}}{1.6 \times 10^{-19}} = 890.73 \approx 891$$

5) $v_0 = 4.50 \times 10^6 \text{ m/s}$

$$v^2 - v_0^2 = 2a \Delta x$$

$$\Delta x = 3.20 \text{ cm}$$

$$a = -\frac{(4.5 \times 10^6)^2}{2(0.0320)} = -3.16 \times 10^{14} \text{ m/s}^2$$

$$v_f = 0$$

$$F = ma \Rightarrow qE = ma \Rightarrow E = \frac{ma}{q} = \frac{(1.67 \times 10^{-27})(3.16 \times 10^{14})}{1.6 \times 10^{-19}}$$

$$E = 3.3 \times 10^6 \text{ N/C}$$

6) $\left(\frac{v_0 + v_f}{2} \right) \Delta t = \Delta x$

$$v = \frac{u}{\gamma} \Rightarrow \Delta v q = \Delta U$$

$$E dq = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_0^2$$

$$E = \frac{m v_0^2}{2 q d}$$

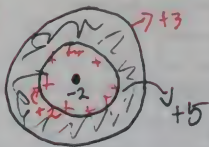
$$\frac{v_0}{2} \Delta t = \Delta x \Rightarrow \Delta t = \frac{2 \Delta x}{v_0}$$

$$t = 14.2 \times 10^{-9} \text{ s}$$

11) $\Phi \Rightarrow qNE$

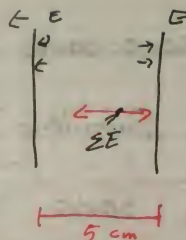
$\hookrightarrow q$ permanece igual $\therefore \Phi$ igual

15)



$$V = -\vec{P} \cdot \vec{E} \quad \leftarrow E_{\text{indipolo}}$$

16) $\sigma_A = -9.50 \text{ nC/m}^2$
 $\sigma_B = -11.60 \text{ nC/m}^2$



$$E = \frac{\sigma}{\epsilon_0}$$

$$E_1 = \frac{\sigma_A}{\epsilon_0} = 1.1 \times 10^5 \text{ V/m}$$

$$E_2 = \frac{\sigma_B}{\epsilon_0} = 1.37 \times 10^5 \text{ V/m}$$

$$E = \frac{\sigma}{2\epsilon_0}$$

$$E_1 = \frac{\sigma_A}{2\epsilon_0} = 5.5 \times 10^4 \text{ V/m}$$

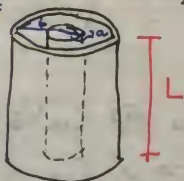
$$E_2 = \frac{\sigma_B}{2\epsilon_0} = 6.85 \times 10^4 \text{ V/m}$$

$$E = 1.19 \times 10^5 (2)$$

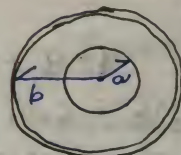
Cap. Placas Paralelas
 $C = \epsilon_0 \frac{A}{d}$

Cap. Placas cilíndricas
 $C = 2\pi\epsilon_0 \frac{L}{\ln(b/a)}$

$b = r_{\text{ext}}$
 $a = r_{\text{int}}$



Cap. Placas Esféricas 26/8/14
 $C = 4\pi\epsilon_0 \frac{ab}{b-a}$



24.6)

$C = 10.0 \text{ nF}$

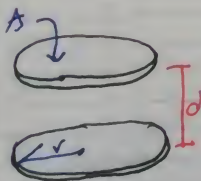
a) 12 V

$V = 12.0 \text{ V}$

b) i) d se duplica $V = ?$ ii) r se duplica $V = ?$

$C = \frac{q}{V} \Rightarrow V = \frac{q}{C}$ i) $V = \frac{q}{C} \Rightarrow V' = \frac{q}{C/2} \Rightarrow V' = 2 \frac{q}{C}$

$V' = 2(V) = 2(12) = 24 \text{ V}$



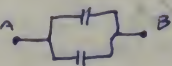
ii) $C = \frac{q}{V} \Rightarrow V = \frac{q}{C} \Rightarrow V' = \frac{q}{4C}$

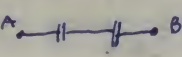
$V' = \frac{1}{4} \left(\frac{q}{C} \right) = \frac{1}{4} V = \frac{1}{4} (12) = 3 \text{ V}$

$A = \pi r^2$
 $A' = \pi (2r)^2$
 $A' = 4\pi r^2$
 $A' = 4A$

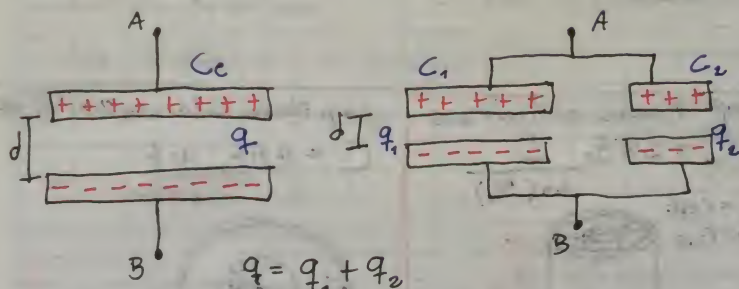
Tarea 24... 1, 3, 5, 7, 9

Capacitores conectados entre sí:

Conexión en Paralelo 

Conexión en serie 

Capacitores en Paralelo:



En paralelo
Dif de Pot
Va a ser
la misma

$$q = q_1 + q_2$$

$$C_e V_e = C_1 V_1 + C_2 V_2 \Rightarrow C_e V_e = C_1 V + C_2 V$$

$$C_e V = V (C_1 + C_2) \Rightarrow C_e = C_1 + C_2$$

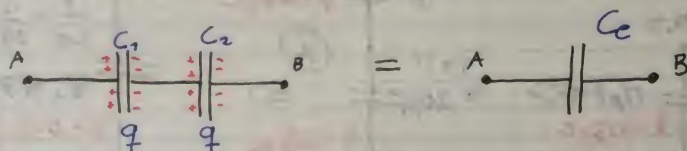
$$\text{ó } C_e = \sum_{i=1}^n C_i$$

$$q = q_1 + q_2 + \dots + q_n$$

$$C_e = C_1 + C_2 + \dots + C_n$$

$$V = V_1 = V_2 = \dots = V_n$$

Capacitores en Serie:



$$V = V_1 + V_2$$

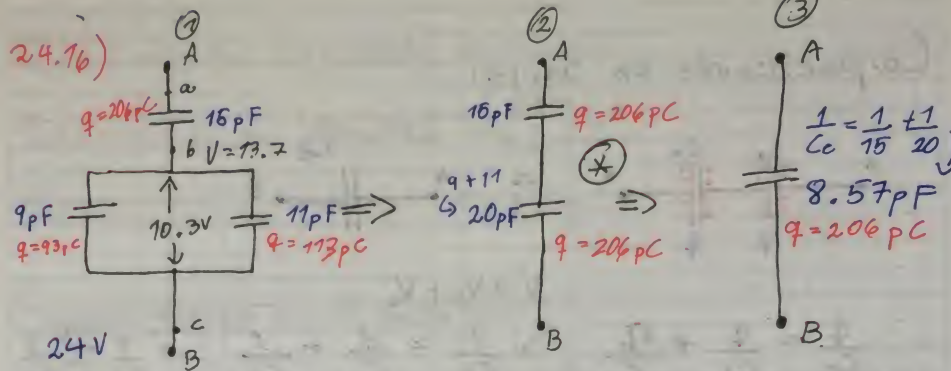
$$\frac{q}{C_e} = \frac{q}{C_1} + \frac{q}{C_2} \Rightarrow \frac{1}{C_e} = \frac{1}{C_1} + \frac{1}{C_2} \quad \text{ó} \quad \frac{1}{C_e} = \sum_{i=1}^n \frac{1}{C_i}$$

	En Paralelo	En Serie
Carga	$q = q_1 + q_2 \dots$	Igual
Capacitancia	$C_e = C_1 + C_2 \dots + C_n$	$\frac{1}{C_e} = \frac{1}{C_1} + \frac{1}{C_2} \dots + \frac{1}{C_n}$
Dif. Potencial	$V_1 = V_2 = V_n$	$V = V_1 + V_2 + \dots$

En paralelo C_e tiene que ser mayor que C_{mayor}

En serie C_e tiene que ser menor que C_{menor}

En paralelo 24... 17, 19, 21



③ $C = \frac{q}{V} = q = CV \Rightarrow q_e = C_e V = (8.57 \times 10^{-12})(24) = 206 \text{ pC}$

⊗ para comprobar $\Sigma = 24$ en este caso

② $= \left(\frac{1}{15} \right) \times 10^{-12} + \left(\frac{206}{20} \right) \times 10^{-12} = 24.0 \text{ V}$

$V_1 = 13.7 \quad + \quad V_2 = 10.3 \text{ V} = 24 \text{ V}$

① $q = CV$

$q_1 = CV = 11 \times 10^{-12} \times 10.3 \text{ V} = 113 \text{ pC}$

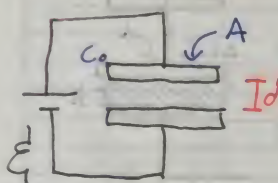
$q_2 = CV = 9 \times 10^{-12} \times 10.3 \text{ V} = 92.7 \text{ pC} \approx 93 \text{ pC}$

Comprobando $q_c = q_1 + q_2 = 113 + 93 = 206 \text{ pC} \checkmark$

1/9/14

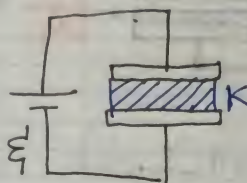
Capacitores con dieléctricos

1) Con Fuente conectada.



$$q_0 = C_0 V$$

$$C_0 = \epsilon_0 \frac{A}{d}$$



$$q = CV = K C_0 V$$

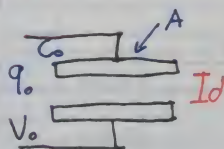
$$q = K q_0$$

$$C = K \epsilon_0 \frac{A}{d}$$

$$C = K C_0$$

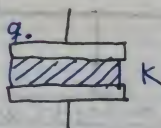
Cuando está conectada aumenta K veces

2) Con Fuente desconectada



$$C = \frac{q_0}{V_0}$$

$$V = \frac{q_0}{C}$$



$$C = K C_0$$

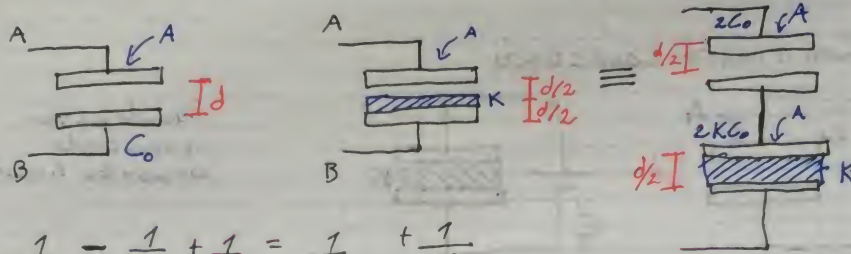
$$V = \frac{q_0}{C}$$

$$V = \frac{q_0}{K C_0} = \frac{1}{K} \frac{q_0}{C_0} = \frac{1}{K} V_0$$

$$V = \frac{V_0}{K}$$

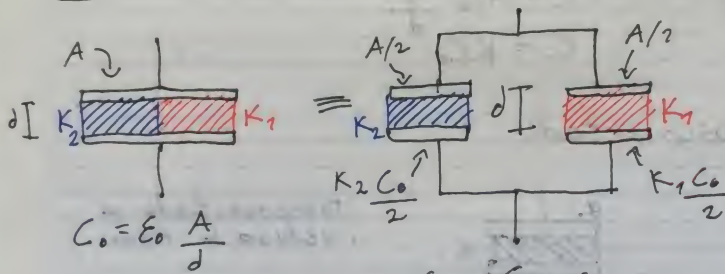
Desconectada se reduce K veces

Llenado Parcial



$$\frac{1}{C_c} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{2C_0} + \frac{1}{2KC_0}$$

$$\frac{1}{C_c} = \frac{K+1}{2KC_0} \Rightarrow C_c = \frac{2KC_0}{K+1} = \frac{2K}{K+1} C_0$$

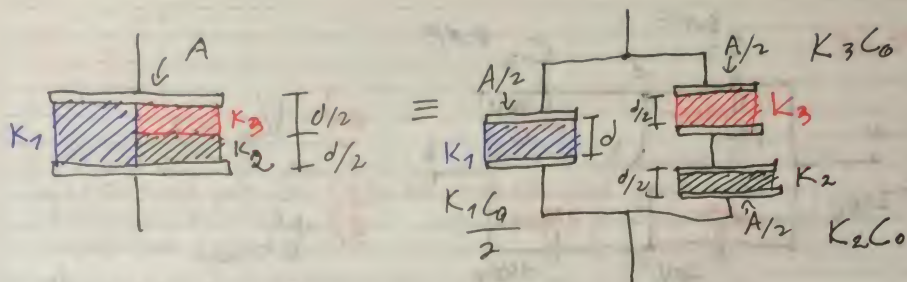


$$C_c = C_1 + C_2$$

$$C_c = \frac{K_1 C_0}{2} + \frac{K_2 C_0}{2}$$

$$C_c = \frac{C_0}{2} (K_1 + K_2)$$

$$C_c = \left(\frac{K_1 + K_2}{2} \right) C_0$$



$$\frac{1}{C_e} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} = \frac{1}{K_1 \epsilon_0} + \frac{1}{K_2 \epsilon_0}$$

$$\frac{1}{C_e} = \frac{K_2 + K_3}{K_1 K_2 K_3 \epsilon_0} \Rightarrow C_e = \left(\frac{K_1 K_2 K_3}{K_2 + K_3} \right) \epsilon_0$$

$$C_e = C_1 + C_2$$

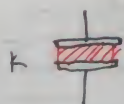
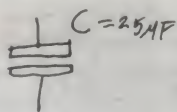
$$C = \epsilon_0 \frac{A/2}{d/2} = \epsilon_0 \frac{A}{d}$$

$$C_e = \frac{K_1 \epsilon_0}{2} + \frac{K_2 K_3}{K_2 + K_3} \epsilon_0 \Rightarrow C_e = \epsilon_0 \left(\frac{K_1}{2} + \frac{K_2 K_3}{K_2 + K_3} \right)$$

$$C = 25 \mu\text{F}$$

$$V = 12.0 \text{ V}$$

$$K = 2.50$$



$$C = \frac{q}{V} \Rightarrow q = CV$$

$$q = (25 \times 10^{-6}) (12) = 300 \mu\text{C}$$

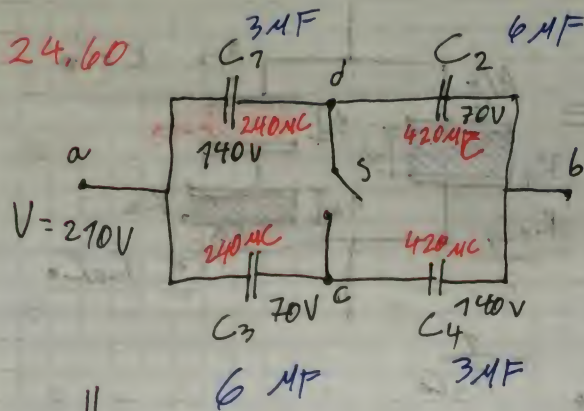
$$U_0 = \frac{q^2}{2C_0} = \frac{(300 \times 10^{-6})^2}{2(25 \times 10^{-6})} = 1.80 \text{ mJ}$$

$$U_F = \frac{q^2}{2C_0} = U_0 = 0.720 \text{ mJ}$$

$$W = \Delta U \Rightarrow U_F - U_0$$

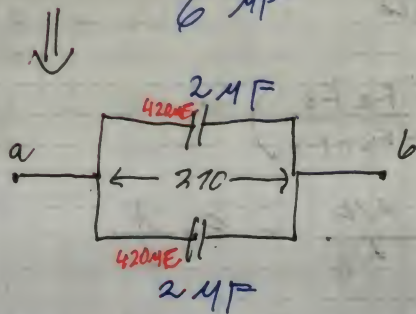
$$W = (0.720 \times 10^{-3}) - (1.80 \times 10^{-3})$$

$$W = -1.08 \times 10^{-3} \text{ J}$$

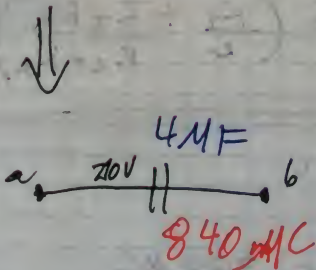


a) $V_{cd} = ?$

b) $V_{c/cap}$
con S cerrado



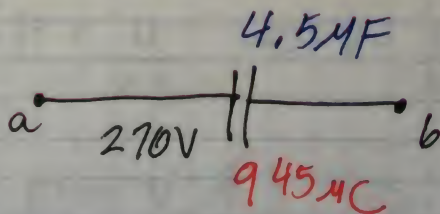
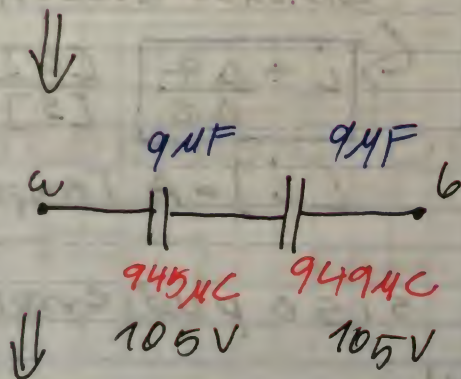
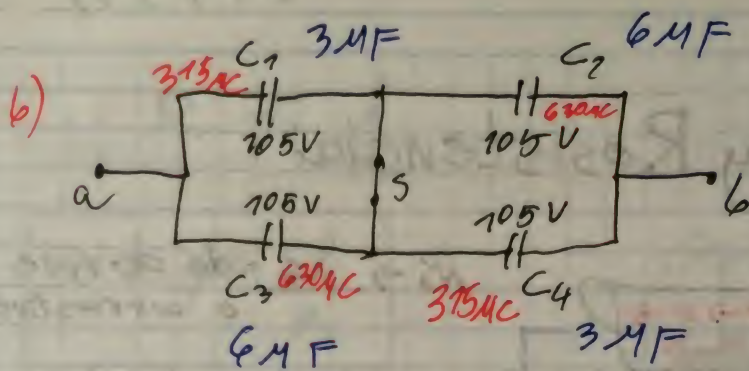
$$\frac{1}{C_c} = \frac{1}{3} + \frac{1}{6}$$



$$V_1 = \frac{q_1}{C_1} = \frac{420\mu C}{3\mu F}$$

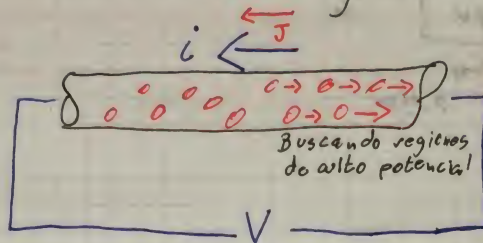
$$V_{cc} = V_c - V_d = 70 - 140 = -70V$$

24., 61, 59, 63, 65



5/9/14

Corriente y Resistencia



$\vec{v}_d \rightarrow v_d = \text{de deriva o arrastre}$

corriente eléctrica

$$i = \frac{\Delta q}{\Delta t} \quad \frac{[C]}{[s]}$$

$$[i] = A \text{ [Amperio]}$$

La corriente va a donde se moverían las cargas positivas si se pudieran mover. (En contra de electrones)

• Densidad de corriente (J)

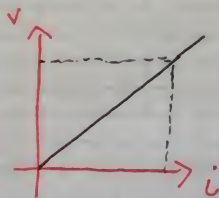
$$J = \frac{i}{A} \quad \frac{[Amp]}{[m^2]}$$

$$\vec{J} = n q \vec{v}_d$$

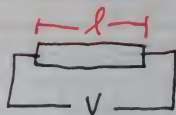
$n = \text{No. electrones libres}$
 $q = \text{carga}$
 $\vec{v}_d = \text{velocidad de arrastre}$

(R)

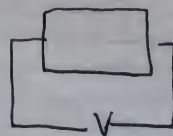
La pendiente es la resistencia eléctrica del material



$$R = \frac{V}{i} \quad \frac{[V]}{[Amp]} \Rightarrow [ohm] \Rightarrow \Omega$$



$$R \propto l$$



$$R \propto \frac{1}{A}$$

Resumen cap 25

$$\therefore R \propto \frac{l}{A}$$

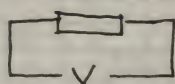
$$R = \rho \frac{l}{A}$$

ρ = Resistividad material

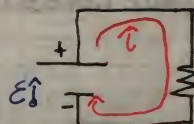
Tabla 25.1 P.823

Potencia Eléctrica

8/9/14



Forma técnica \Rightarrow



$$P = \frac{u}{\Delta t} \Rightarrow V = \frac{u}{q} \Rightarrow u = Vq$$

$$P = \frac{Vq}{\Delta t} \Rightarrow P = Vi$$

$$R = \frac{V}{i} \Rightarrow V = iR \Rightarrow i = \frac{V}{R}$$

$$P = Vi \Rightarrow P = (iR)i$$

$$P = i^2 R$$

$$P = Vi \Rightarrow P = V\left(\frac{V}{R}\right) \Rightarrow P = \frac{V^2}{R}$$

ej) Loces en clase

$$P = Vi$$

$$P = 1,600 \text{ W}$$

$$i = \frac{P}{V} = \frac{1,600 \text{ W}}{110 \text{ V}} = 14.5 \text{ A}$$

$$\Delta \rho = \rho_0 \alpha (T - T_0) \rightarrow T_0 = 20^\circ \text{C} \cdot \text{Temp ambiente}$$

$$\rho - \rho_0 = \rho_0 \alpha (T - T_0)$$

$$\boxed{\rho = \rho_0 (1 + \alpha \Delta T)}$$

$$\rho \frac{L}{A} = \rho_0 \frac{L}{A} (1 + \alpha \Delta T) \Rightarrow \boxed{R = R_0 (1 + \alpha \Delta T)}$$

Superconductores: materiales a temp muy baja

25.4)

$$\text{Cobre } \rho = 1.72 \times 10^{-8} \Omega \cdot \text{m}$$

$$\phi = 1.02 \text{ mm}$$

$$J = 1.50 \times 10^6 \frac{\text{A}}{\text{m}^2}$$

$$n = 8.50 \times 10^{28}$$

$$a) i = ?$$

$$b) v_d = ?$$

$$\oint \frac{2\pi \phi^2}{4} = \frac{2\pi R^2}{2}$$

$$J = \frac{i}{A} \Rightarrow i = JA = (1.50 \times 10^6 \frac{\text{A}}{\text{m}^2}) (\frac{\pi (1.02 \times 10^{-3} \text{ m})^2}{4})$$

$$i = 1.22 \text{ A}$$

$$J = n q v_d \Rightarrow v_d = \frac{J}{n q} = \frac{1.50 \times 10^6}{(8.50 \times 10^{28})(1.6 \times 10^{-19})}$$

$$v_d = 0.110 \text{ mm/s}$$

25... 1, 3, 5, 11, 13

25.14)

$$L = 6.50 \text{ m}$$

$$\phi = 2.05 \text{ mm}$$

$$R = 0.0290 \Omega$$

a) $\rho = ?$ (material)

b) $R = ?$ a 150°C

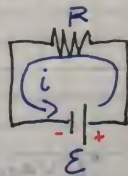
$$R = \rho \frac{L}{A} \Rightarrow \rho = R \frac{A}{L} = (0.0290) \frac{\pi (0.00205)^2}{4 (6.50)}$$

$$\rho = 1.47 \times 10^{-8} \Omega \text{ m} \Rightarrow \text{Plata}$$

$$R = R_0 (1 + \alpha \Delta T)$$

$$R = 0.0290 \Omega (1 + 0.0038 (130^\circ)) = 0.043 \Omega$$

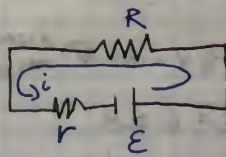
Aparatos de Medición



$$V = iR$$

$$\mathcal{E} - iR = 0$$

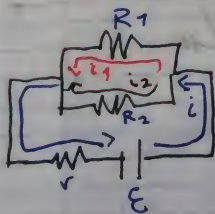
$$\mathcal{E} = iR$$



$$\mathcal{E} - iR - ir = 0$$

$$\mathcal{E} = iR + ir$$

$$\mathcal{E} = i(R + r)$$

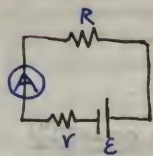


$$i = i_1 + i_2$$

25, 28, 29, 31, 33, 35

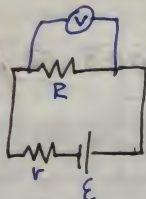
• Amperímetro:

Mide corriente, se conecta en serie



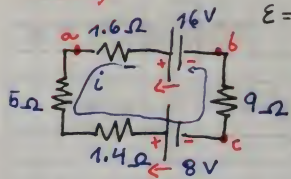
$R_A \rightarrow 0$ Para no interferir

• Voltímetro:



$R_v \rightarrow \infty$ Para que no afecte

25, 32)



$E = 16V - 8V = 8V$ dirección mas grande a) $i = ?$

a) $E = i \Sigma R$

$$i = \frac{8V}{(1.6 + 5 + 1.4 + 9)}$$

$$i = 0.471 \text{ AMP}$$

b) V_{ab}

c) V_{ac}

"i" va al otro sentido

b) $V_b + 16V - (0.471)(1.60) = V_a$

$$V_b + 15.2 = V_a \Rightarrow V_a - V_b = 15.2V_H$$

inverso

$$V_a = 1.6(-0.471) - 16 = V_b$$

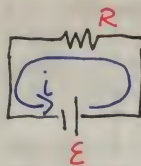
$$V_a - 15.2 = V_b$$

c) $V_a - 1.6(-0.471) - 16 - 9(-0.471) = V_c$

$$V_a - 11.0 = V_c \Rightarrow V_a - V_c = 11.0V$$

$$\hookrightarrow V_a - 5(0.471) - 1.4(0.471) - 8 = V_c$$

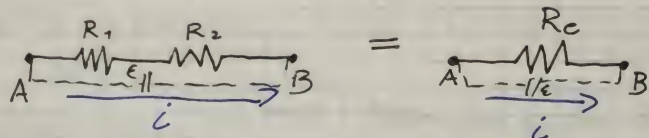
Circuitos de Corriente Directa



$$R = \frac{V}{i}$$

Conexiones en serie y paralelo

Resistencia en Serie

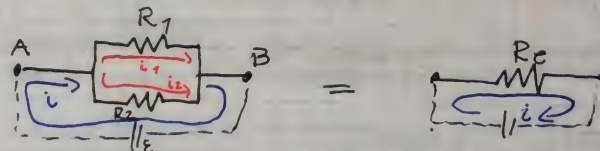


Caida de Potencial

$$\hookrightarrow V_e = V_1 + V_2 \Rightarrow i R_e = i R_1 + i R_2$$

$$\Rightarrow \boxed{R_e = R_1 + R_2} \text{ En serie}$$

Resistencia en Paralelo



$$i_e = i_1 + i_2$$

$$V - V = V$$

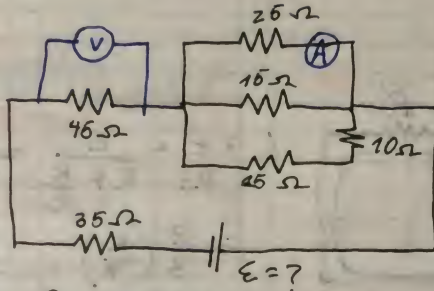
$$\frac{V}{R_e} = \frac{V}{R_1} + \frac{V}{R_2}$$

$$\hookrightarrow \boxed{\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2}}$$

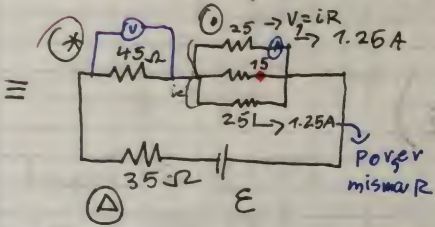
$$\hookrightarrow \frac{1}{R_e} = \sum_{i=1}^n \frac{1}{R_i}$$

26... Resimlen

26.6)



$$I = 1.25 A$$



$$V_1 = IR = (1.25)(25) = 31.25 \text{ V}$$

↳ En todas las que están en paralelo

$$\bullet \quad i = \frac{V}{R} = \frac{37.25}{18} = 2.08 \text{ Amp}$$

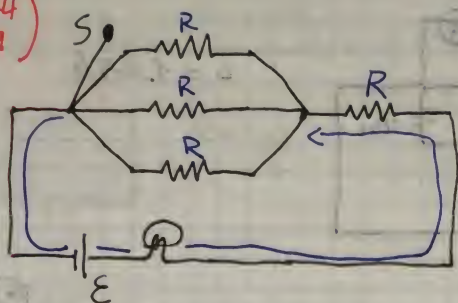
$$I_e = 1.25 + 1.25 + 2.08 = 4.58 \text{ Amp}$$

$$(*) V = iR = (4.58)(45) = \underline{206.25 \text{ V}}$$

$$\textcircled{\Delta} V = iR = (4.58)(35) = \underline{160.3_H}$$

$$\mathcal{E} = 31.25 + 206.25 + 160.3 = \underline{\underline{397.8 \text{ V}}}$$

P874)
26.9)

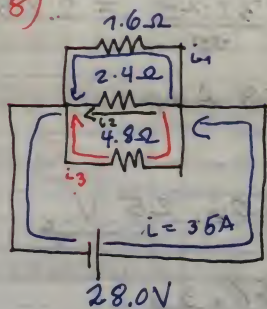


$$I = \frac{E}{R_c} = \frac{E}{R + \frac{R}{2}} = \frac{2E}{3R}$$

$$= \frac{2}{3} \left(\frac{E}{R} \right)$$

$$I = \frac{E}{R_c} = \frac{E}{R + \frac{R}{3}} = \frac{3}{4} \left(\frac{E}{R} \right)$$

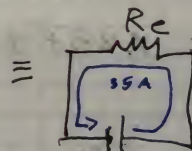
26.8)



a) $R_c = ?$

b) $i_{4R} = ?$

c) $i_{Tot} = ?$



E , Max pequeña
que lev. mas pequeña

$$\frac{1}{R_c} = \frac{1}{1.6} + \frac{1}{2.4} + \frac{1}{4.8} \Rightarrow R_c = 0.8 \Omega$$

$$I = \frac{V}{R} = \frac{E}{R} \Rightarrow I = \frac{28.0V}{0.800\Omega} = 35.0A$$

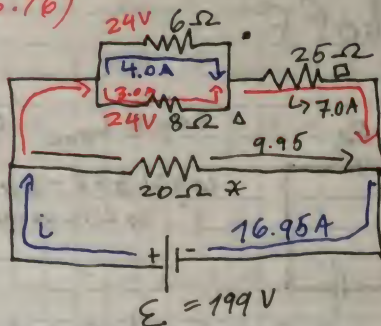
$$i_1 = \frac{E}{R_1} = \frac{28.0}{1.60} = 17.5 ; P_1 = V i_1 = (28)(17.5) = 490W$$

$$i_2 = \frac{E}{R_2} = \frac{28.0}{2.4} = 11.67 ; P_2 = V i_2 = (28)(11.6) = 326.76W$$

$$i_3 = \frac{E}{R_3} = \frac{28.0}{4.8} = 5.83 ; P_3 = V i_3 = (28)(5.8) = 163.24W$$

26... 1, 3, 5, 9, 11, 13

26.76)



$$* i = \frac{V}{R} = \frac{199}{20} = 9.95$$

$$i_{Tot} = (7A) + (9.95A)$$

$$i_{Tot} = 16.95A$$

a) $i_{20} = ?$ 9.95 A
 $i_{25} = ?$ 7A $\rightarrow 4 + 3$

$$V = iR = (4)(6) = 24V$$

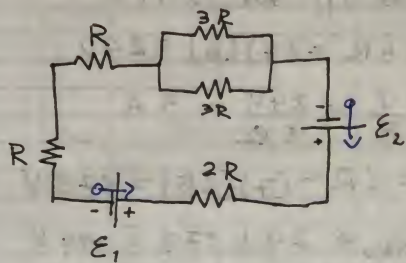
$$\Delta i = \frac{V}{R} = \frac{24V}{8\Omega} = 3A$$

$$V = iR = (7)(25) = 175V$$

$$V_{arriba} = 24 + 175 = 199V$$

$$\therefore V_{enmedio} y E = 199V$$

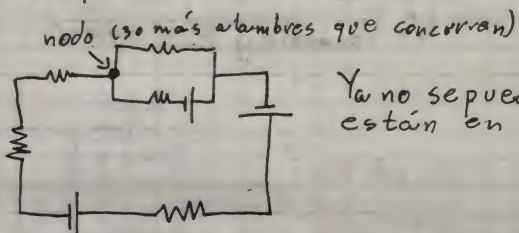
Leyes de Kirchhoff.



Ley 1) $i_{ent} = i_{sal}$

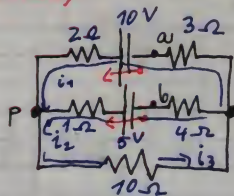
Ley 2) $\sum \uparrow P - \sum \downarrow P = 0$
 \hookrightarrow Circ cerrado

\hookrightarrow Suponiendo $E_1 > E_2$



Ya no se puede ya que las FEM no están en la misma línea

26.28)



$i_1 + i_2 = i_3$ ①

$i_1 + i_2 - i_3 = 0$

② $V_p = 10i_3 - 3i_1 + 10 - 2i_1 = V_p$

$10 - 10i_3 - 5i_1 = 0 \Rightarrow i_1 + 2i_3 = 2$

③ $-10i_3 - 4i_2 + 5 - 1i_2 = 0$

$5 - 10i_3 - 5i_2 = 0 \Rightarrow 2i_3 + i_2 = 1$

26... 25, 27, 29

$$i_1 + i_2 - i_3 = 0$$

$$i_1 + \cancel{i_2} + 2i_3 = 0$$

$$i_2 + 2i_3 = 1$$

$$\left\{ \begin{array}{l} i_1 + i_2 - i_3 = 0 \\ -i_1 \quad -2i_3 = 0 \end{array} \right.$$

$$i_2 - 3i_3 = 1$$

$$-i_2 - 2i_3 = -1$$

$$-5i_3 = 0$$

$$i_3 = 0.6$$

a)

$$i_1 = 0.8 \text{ A}$$

$$i_2 = -0.2 \text{ A} \rightarrow \text{Otro sentido}$$

$$i_3 = 0.6 \text{ A}$$

b)

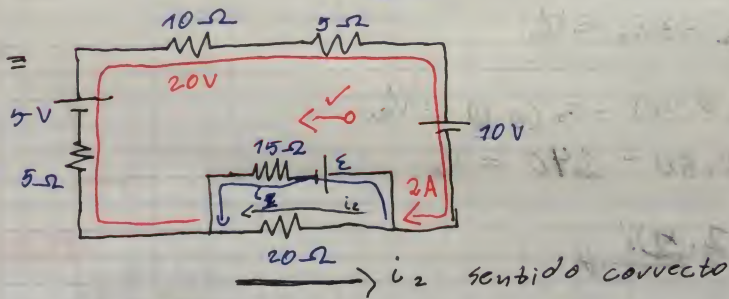
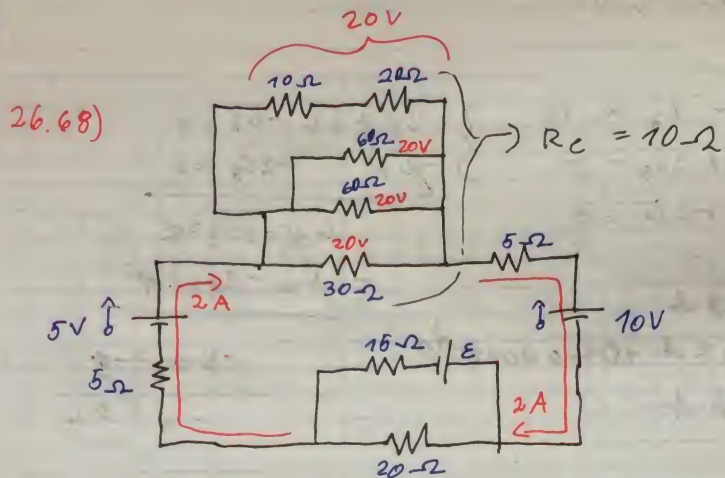
$$V_b - 4i_2 - 3i_1 = V_a$$

$$V_b - 4(0.20) - 3(0.8) = V_a$$

$$V_b - 0.80 - 2.40 = V_a$$

$$V_b - V_a = 3.2 \text{ V}$$

26... 33, 61, 63, 65, 66



$$i_1 + i_2 = 2$$

- $\mathcal{L}(5+10+5)$ De la parte igual

$$-2(20) + 5 - 10 - 20i_2 = 0$$

$$\Rightarrow i_2 = -2.25 \text{ A} \quad \therefore i_1 = 4.25 \text{ A}$$

$$-20(2.25) - \varepsilon - 15(4.25) = 0$$

$$\Rightarrow \mathcal{E} = -108.75 \text{ V}$$

b) 60 J $t = ?$

$$70 \text{ i} + 20 \text{ l} = 20$$

$$i(10+20) = 20$$

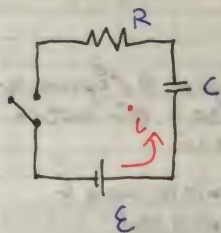
$$I = \frac{20}{10+20} = 0.67 \text{ A}$$

$$P = i^2 R = (0.667)^2 (10) = 4.44 \text{ W}$$

$$P = \frac{W}{\Delta t} \Rightarrow \Delta t = \frac{W}{P} = \frac{60 \text{ J}}{4.44 \text{ W}} = 13.64 \text{ s}$$

Circuito abierto capacitor actúa como alambre
 Capacitor cargado actúa como alambre cortado

Circuitos RC



$$t=0$$

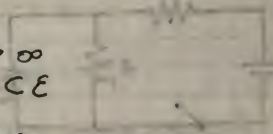
$$q=0$$

$$i=i_{\max}=\frac{\varepsilon}{R}$$

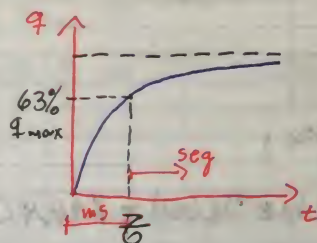
$$t \rightarrow \infty$$

$$q=C\varepsilon$$

$$i=0$$



Gráfica característica de un circuito RC



$\tau \Rightarrow$ constante capacitiva de tiempo

$$\text{magnitud } \langle \tau \rangle = \frac{10^3}{R} \times \frac{10^{-6}}{C} = 10^{-3} \text{ s} \approx \text{ms}$$

Si dicen tiempo en seg = q_{\max}

$$\tau = RC$$

$$q = C\varepsilon (1 - e^{-t/RC})$$

$$e^{-t/RC} \text{ cuando } t \rightarrow \infty = 0$$

$$i = i_{\max} e^{-t/RC} \Rightarrow \frac{\varepsilon}{R} e^{-t/RC}$$

$$q = q_{\max} e^{-t/RC}$$

$$q_{\max} = C\varepsilon$$

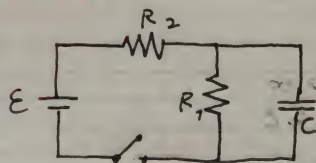
$$i = -\frac{\varepsilon}{R} e^{-t/RC} \rightarrow \text{descarga}$$

(no hay ε)



26... 41, 43, 45

25.83)



En $t=0$

$$q = 0$$

$$i = \frac{E}{R_2}$$

Debido a que R_1 es por la corriente y dC actúa como alambre

En $t \rightarrow \infty$

Ya que está en paralelo con C y en paralelo V es igual

$$q = CV = C \left(\frac{E}{R_1 + R_2} \right) R_1$$

$$i = \frac{E}{R_1 + R_2}$$

26.42)

$$C = 12.4 \mu F$$

$$R = 0.895 M\Omega$$

$$V = 60.0 V$$

$$a) t = 0.05$$

$$b) t = 5.05$$

$$c) t = 10.05$$

$$d) t = 20.05$$

$$e) t = 100.05$$

$$a) q = q_{max} (1 - e^{-t/RC})$$

$$q_{max} = CE = (12.4 \times 10^{-6})(60) = 744 \mu C$$

$$RC = (0.895 \times 10^6)(12.4 \times 10^{-6}) = 11.1 s$$

$$q = 0$$

$$b) q = (744 \times 10^{-6})(1 - e^{-5/11.1}) = 2.70 \times 10^{-4}$$

$$c) q = (744 \times 10^{-6})(1 - e^{-10/11.1}) = 4.48 \times 10^{-4}$$

$$d) = 6.21 \times 10^{-4}$$

$$e) = 7.44 \times 10^{-4}$$

29/9/14

P 878
26.46)

$$C = 1.504F$$

$$R = 12.0 \Omega$$

$$\mathcal{E} = 10.0 V$$

$$i = ?$$

$$\text{con } q = \frac{1}{4} q_{\max}$$

$$q = q_{\max} (1 - e^{-t/RC})$$

$$0.25 q_{\max} = q_{\max} (1 - e^{-t/RC})$$

$$0.75 = e^{-t/RC}$$

$$e^{t/RC} = \frac{1}{0.75} \Rightarrow \frac{t}{RC} = \ln\left(\frac{1}{0.75}\right)$$

$$t = RC \ln\left(\frac{1}{0.75}\right) = (12)(1.5 \times 10^{-6}) \ln\left(\frac{1}{0.75}\right)$$

$$t = 5.18 \mu s$$

$$i = i_{\max} e^{-t/RC}$$

$$i = \frac{\mathcal{E}}{R} e^{-t/RC} = \frac{10}{12} e^{-(5.18 \times 10^{-6}) / (12)(1.5 \times 10^{-6})} = 0.625 A$$

P2